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1955 MEAN MONTHLY WIND SUMMARY ALONG RECONNAISSANCE TRACK NORTHWEST OF HAWAIIAN ISLANDS AT 500 MB.

GORDON A. DEAN

Institute of Geophysics, University of California[1, 2]

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ABSTRACT

The mean 1955 monthly variation of the zonal and meridional wind components, and the wind steadiness are presented for the 500-mb. level, from 20°–40° N. in the longitude of the Hawaiian Islands. The basic wind information used in the construction of these charts was obtained from the daily weather reconnaissance flight on the track designated "Petrel Foxtrot." Mean monthly 500-mb. wind charts were also prepared for the Hawaiian Islands area from the same wind sample.

1. INTRODUCTION

Almost no climatological information about the wind field is available over the oceanic region to the north of the Hawaiian Islands. Mean monthly summaries of winds from sailing ships still provide the most detailed surface wind information (Werenskiöld [1]). The only existing upper-level wind information must be derived from mean contour charts (U. S. Weather Bureau [2]).

Meteorological data are being obtained daily by reconnaissance flights to the north of the Hawaiian Islands. In the past, reconnaissance data to the north of Hawaii have been taken at various flight levels and over several different flight tracks. During 1955 one flight track designated "Petrel Foxtrot" was flown regularly. The daily Petrel Foxtrot outbound, or low-level, leg was flown at 1,500 feet, and the return, or high-level, leg was flown at 500 mb. Observations were taken daily at fixed geographic positions on the flight track. This daily source of wind information provides the basic data for a mean monthly wind summary.

In this study, only the 500-mb. reconnaissance winds were considered. The winds were observed at 100-mile

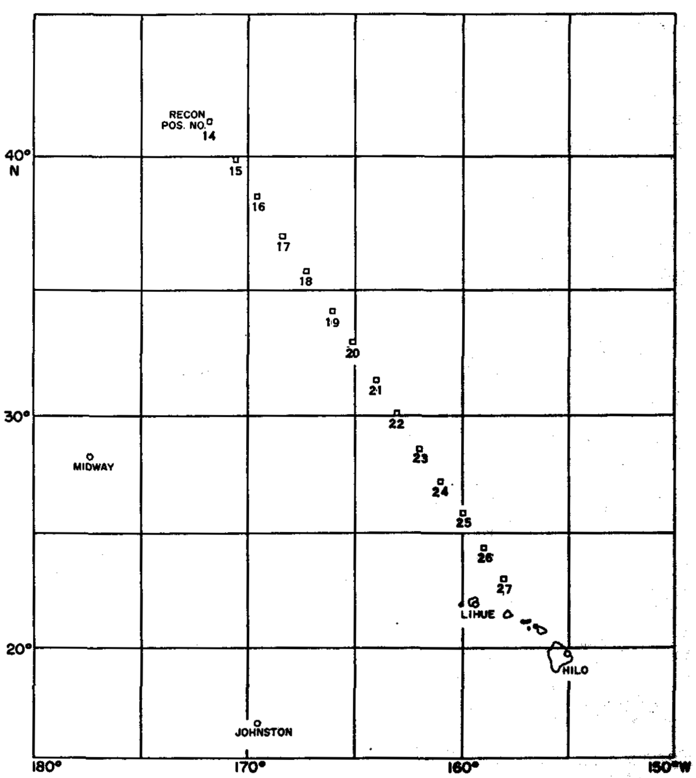

Figure 1.—Location of "Petrel Foxtrot" reconnaissance positions at 500-mb. north of the Hawaiian Islands during 1955–1956.

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[2] Present affiliation—Florida State University.

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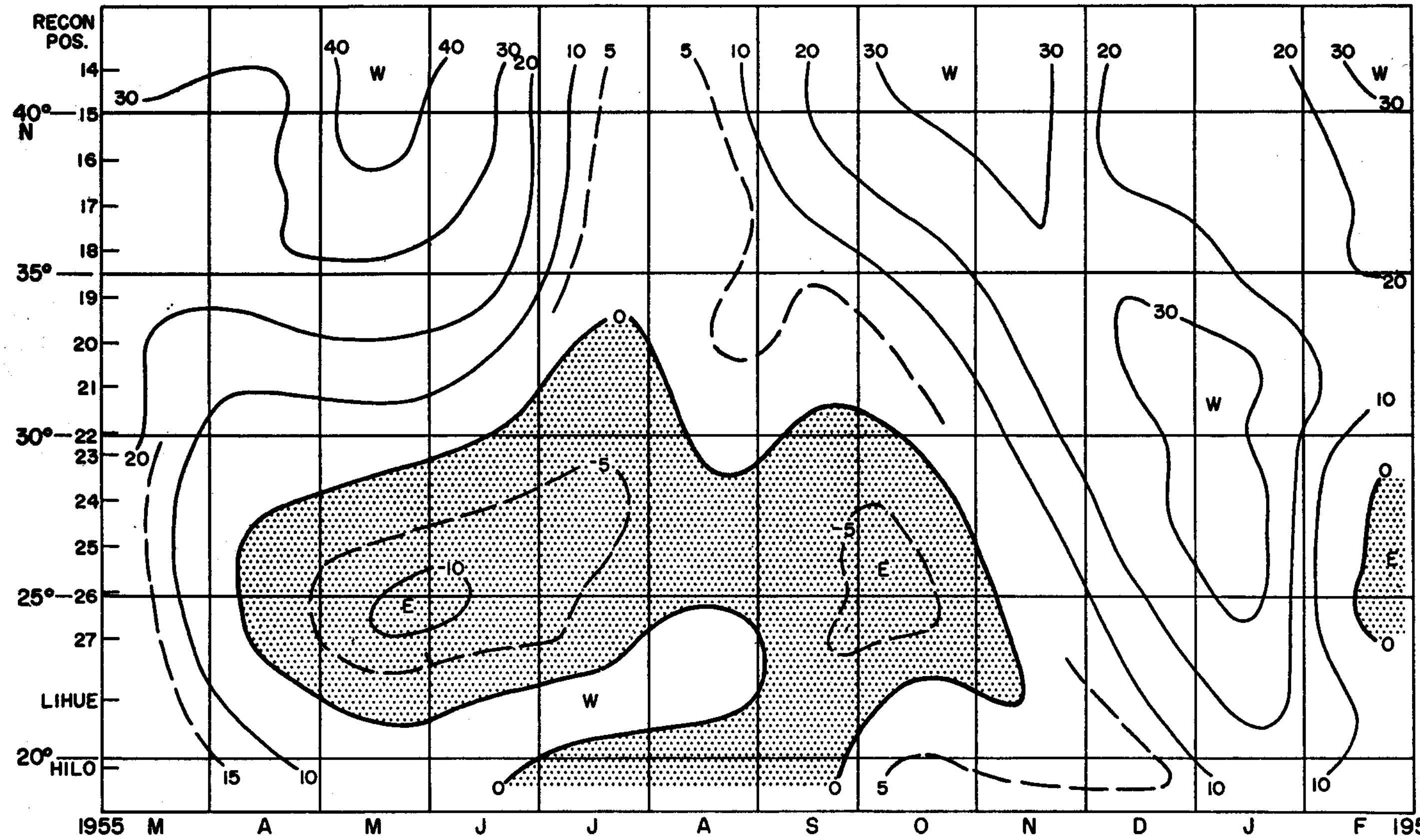

Figure 2.—Variation of the east-west wind component by latitude and month at 500 mb. between 155° and 170° W. during 1955-1956 (knots).

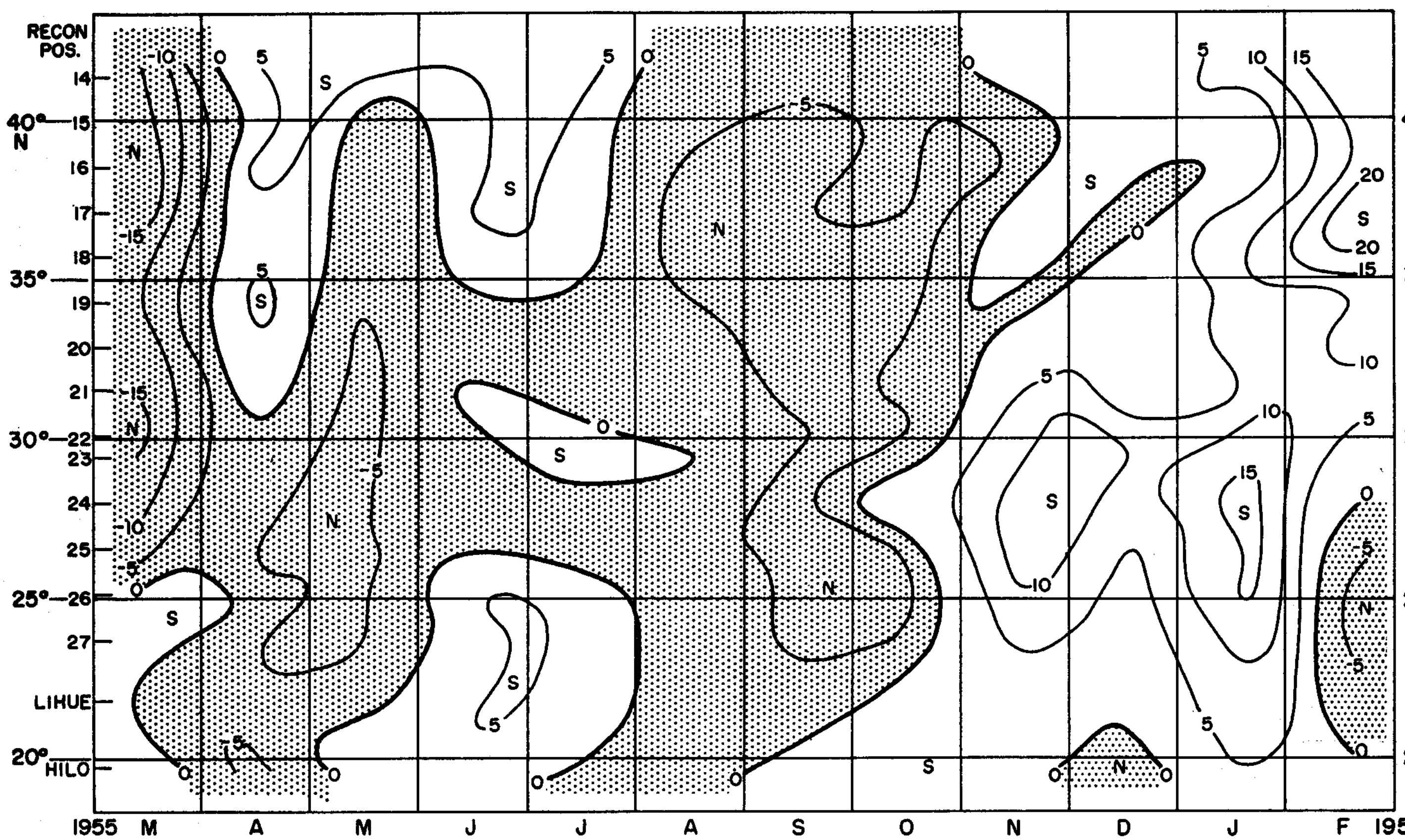

Figure 3.—Variation of the north-south wind component by latitude and month at 500 mb. between 155° and 170° W. during 1955–1956 (knots).

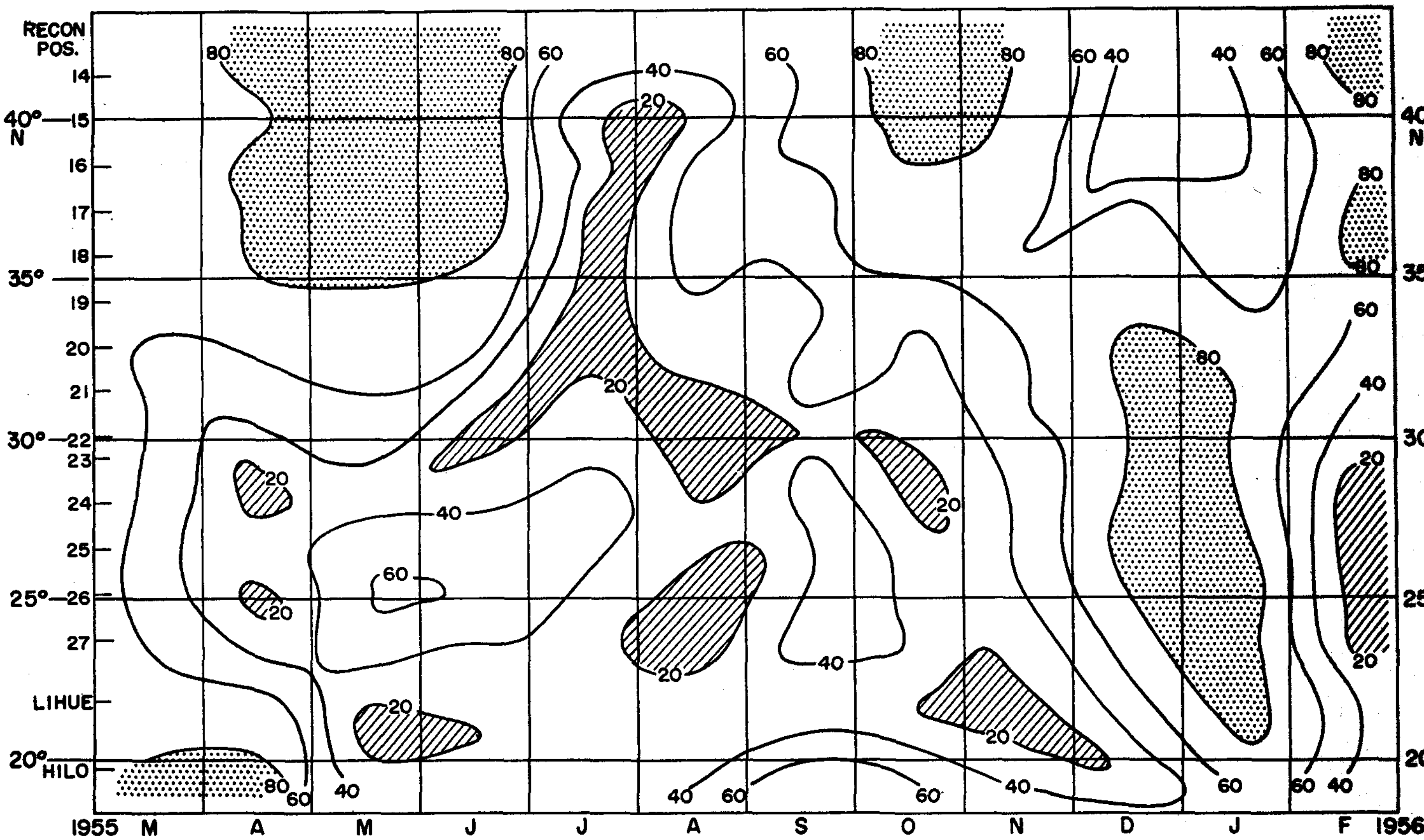

FIGURE 4.—Variation of the wind steadiness by latitude and month at 500 mb. between 155° and 170° W. during 1955–1956 (percent).

intervals between position 14—the northernmost position on the track (near 2345 GMT) and position 27—southernmost position (near 0615 GMT) (fig. 1). Double drift wind observations were made when possible at all positions. However, the Petrel flight track length and duration in time were such that for the last 500 miles (positions 23–27), the wind observations had to be based upon loran fixes because of darkness. Loran winds are average winds usually taken over a 100-mile distance on reconnaissance flight and are, therefore, applicable to the mid-point position. On occasion some average winds had of necessity to be taken between positions 14 and 22 due to cloudy weather conditions. Such average winds were few in number and have been included statistically as though they were double drift winds, thereby sacrificing some data accuracy in order to maintain a larger sampling of cases.

2. ANALYSIS OF DATA

All 500-mb. wind observations for individual reconnaissance positions were tabulated by month. In addition, the 0300 and 1500 GMT 500-mb. winds for Lihue, Hilo, Midway, and Johnston were compiled. The winds were then processed to obtain the following wind parameters: $\bar{u}$, the mean east-west wind component; $\bar{v}$, the mean north-south wind component; $\bar{c}$, the mean scalar wind speed; $|\bar{V}|$, the mean resultant wind speed; and $\bar{s}$, the mean wind steadiness. The steadiness of the wind as used here is defined as the ratio of the resultant wind speed to the scalar wind speed.

The mean monthly latitudinal variation of the east-west wind component is shown in figure 2. This chart demonstrates that the ocean area around and especially to the north of the Hawaiian Islands at 500 mb. was dominated by westerly winds throughout most of the year 1955. During the months, April to October, an enclosure of easterly winds appeared within the westerly winds. The northern boundary of the enclosure (between westerly and easterly winds) located near 30° N. represents the mean location of the subtropical anticyclonic belt. Of significant interest was the absence of the anticyclonic belt in these longitudes during the winter months of the year. The southern boundary of the enclosure (between easterly and westerly winds) was located near Kauai during the period April to October 1955 and represents the location of an upper level cyclone or trough, oriented east-northeast—west-southwest, south of the subtropical anticyclonic belt. At higher levels, for example at 30,000 feet, the upper-level trough was often more clearly defined. It could be observed to stretch from the Marshall Islands eastward and often entered the United States over southern California (Riehl [3]).

During the winter, mean maximum speeds north of Hawaii at 500 mb. ranged from 25 to 35 knots; however,

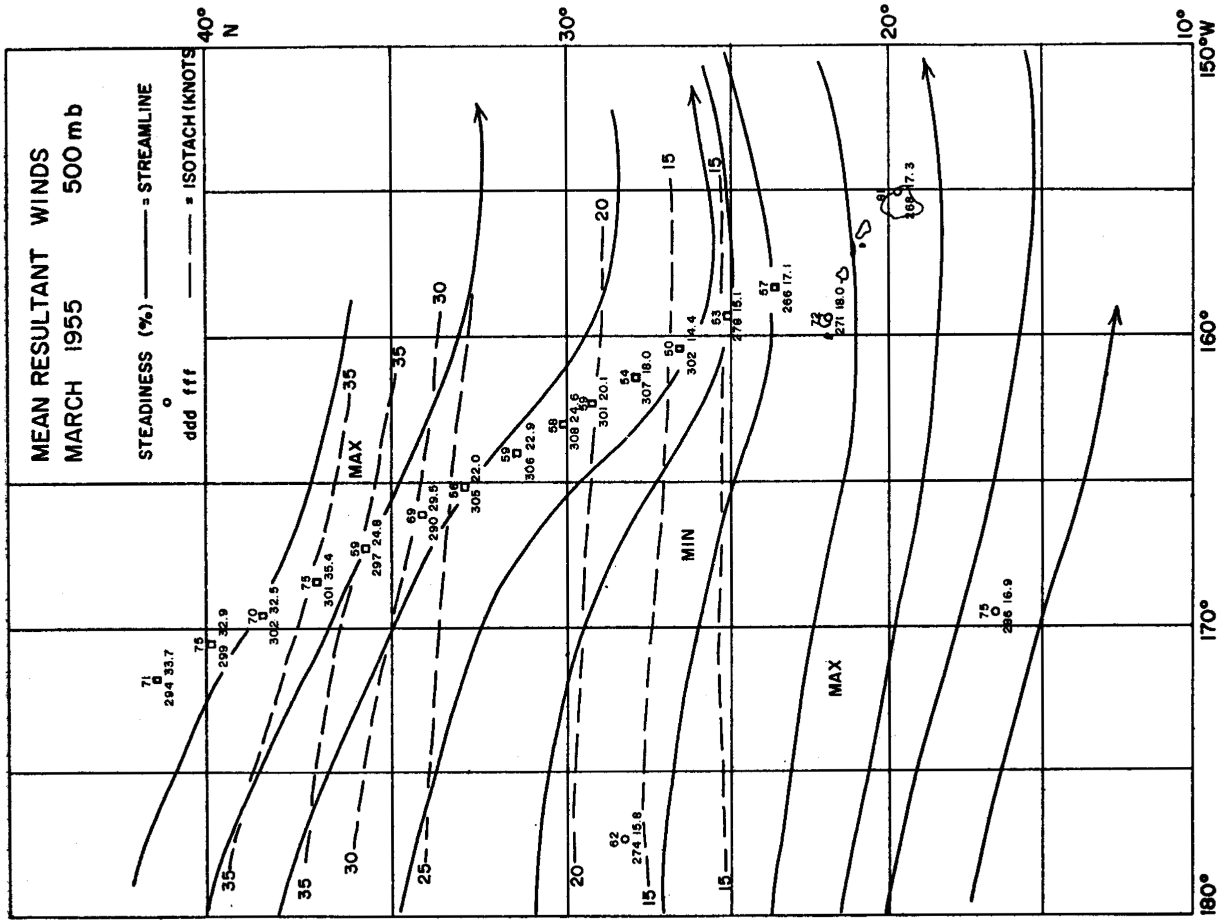

FIGURE 5.—The field of motion at 500 mb., March 1955.

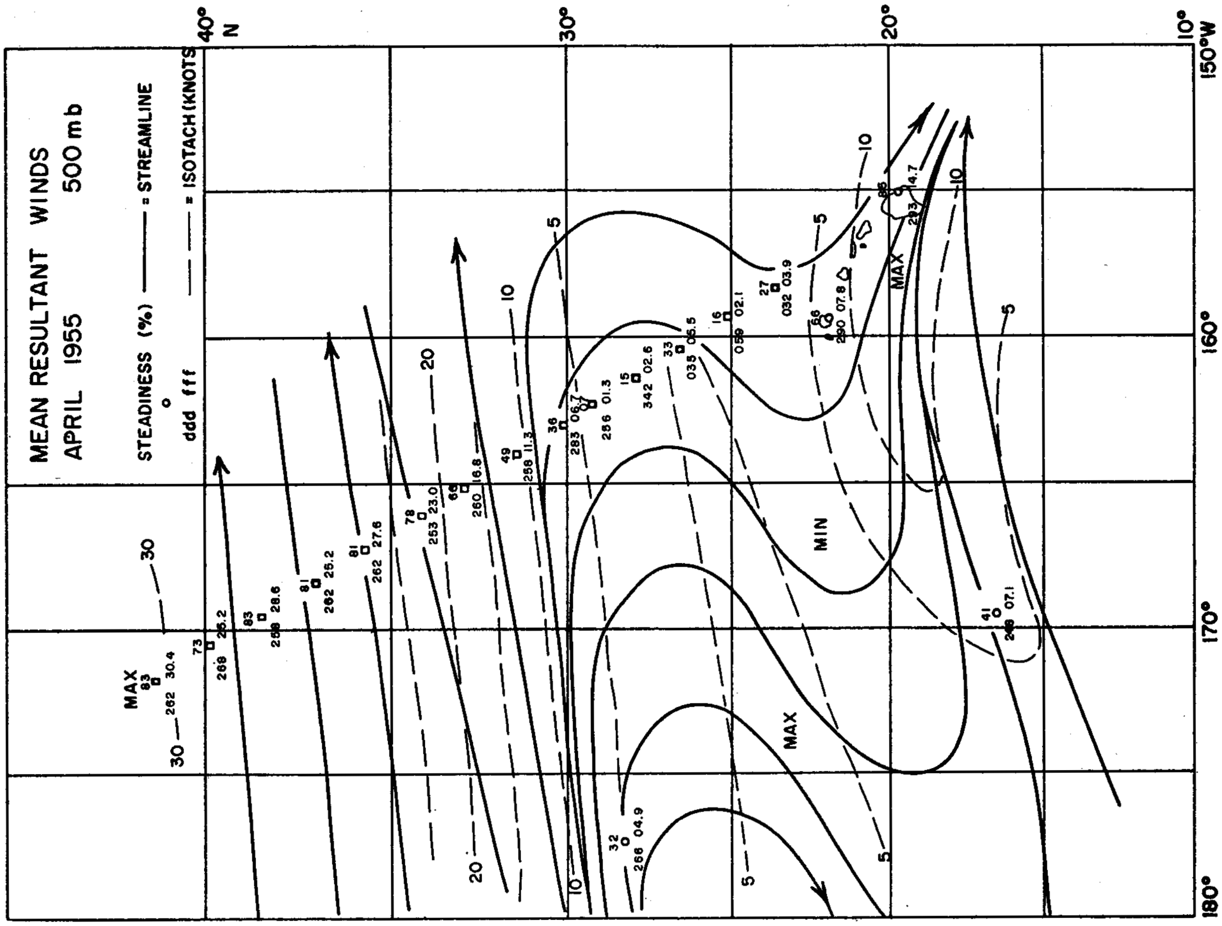

FIGURE 6.—The field of motion at 500 mb., April 1955.

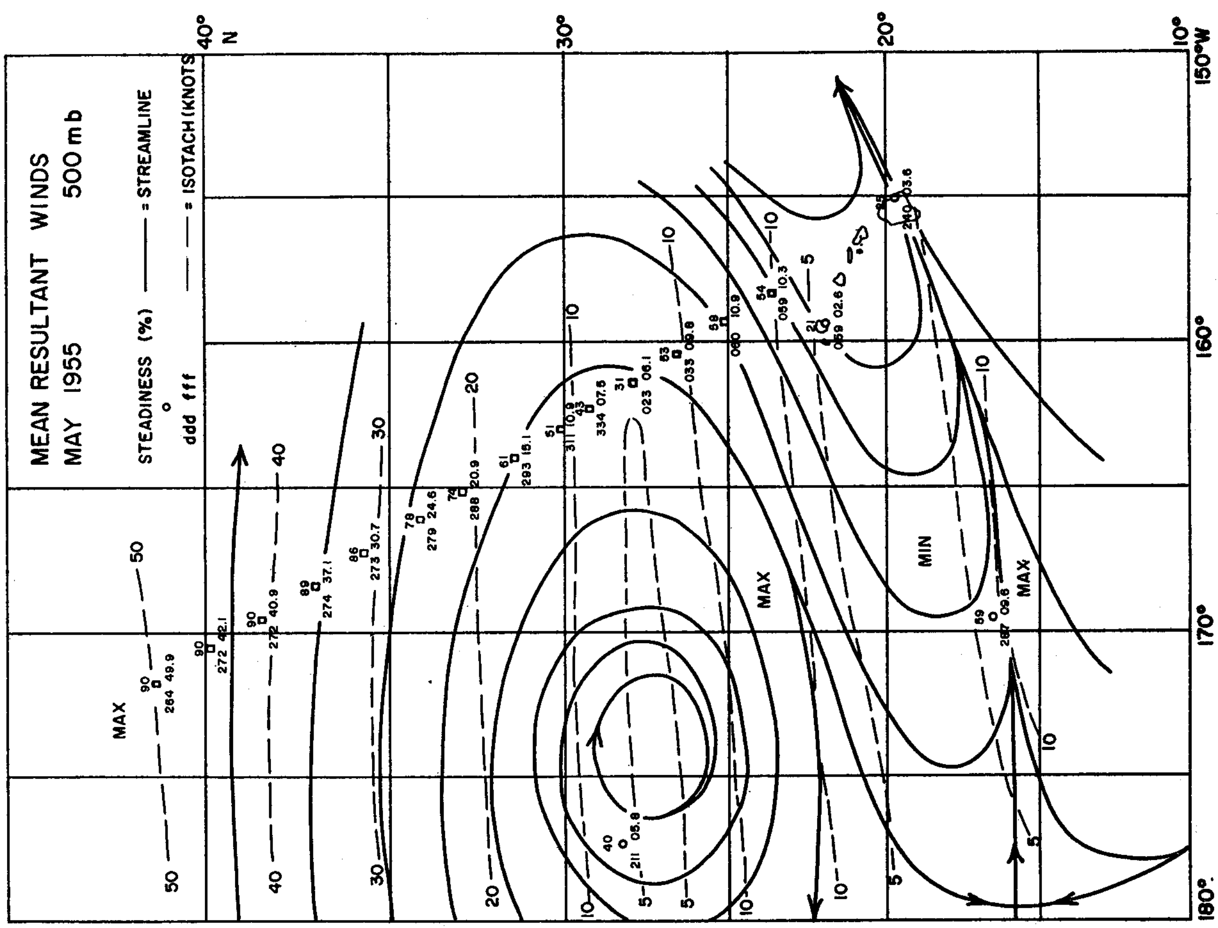

FIGURE 7.—The field of motion at 500 mb., May 1955.

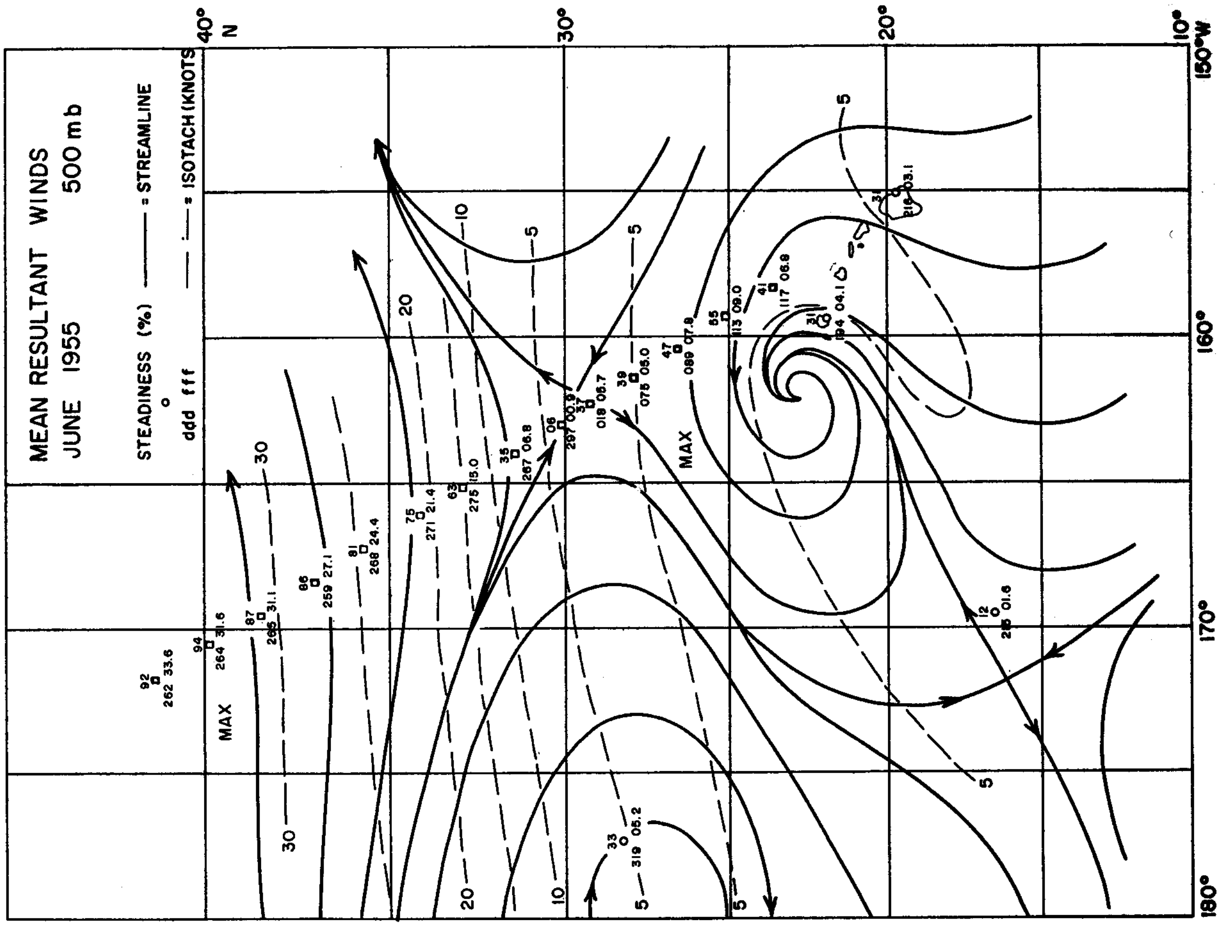

FIGURE 8.—The field of motion at 500 mb., June 1955.

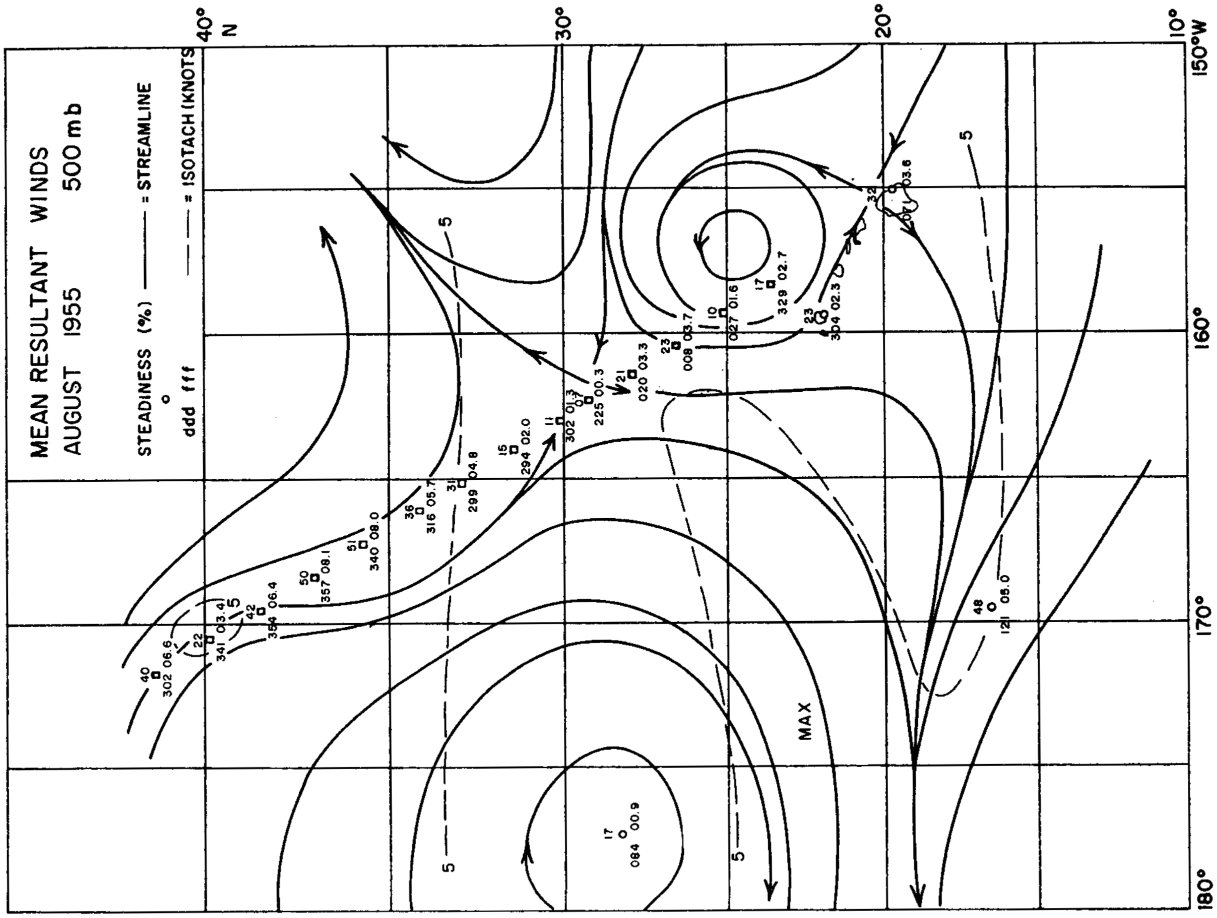

FIGURE 10.—The field of motion at 500 mb., August 1955.

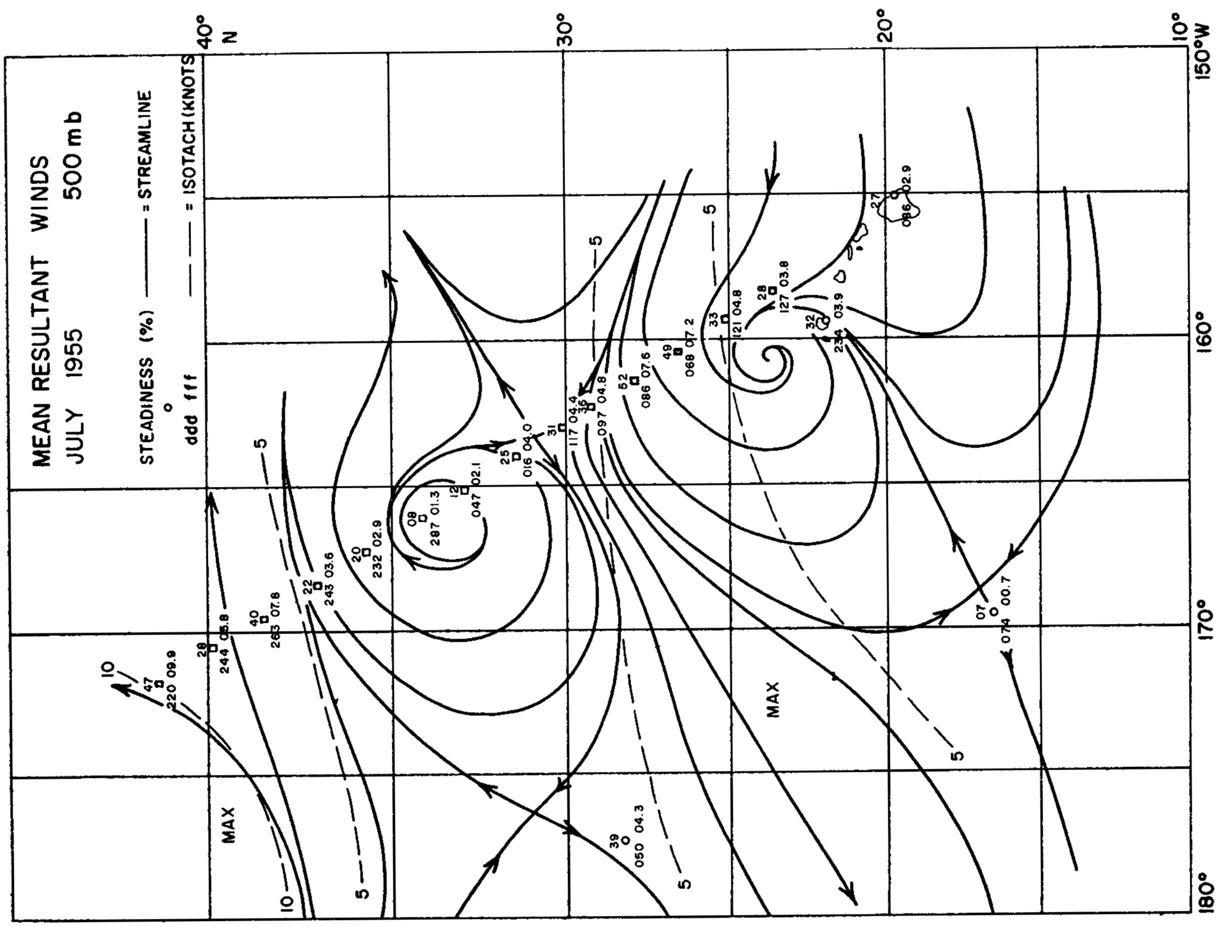

FIGURE 9.—The field of motion at 500 mb., July 1955.

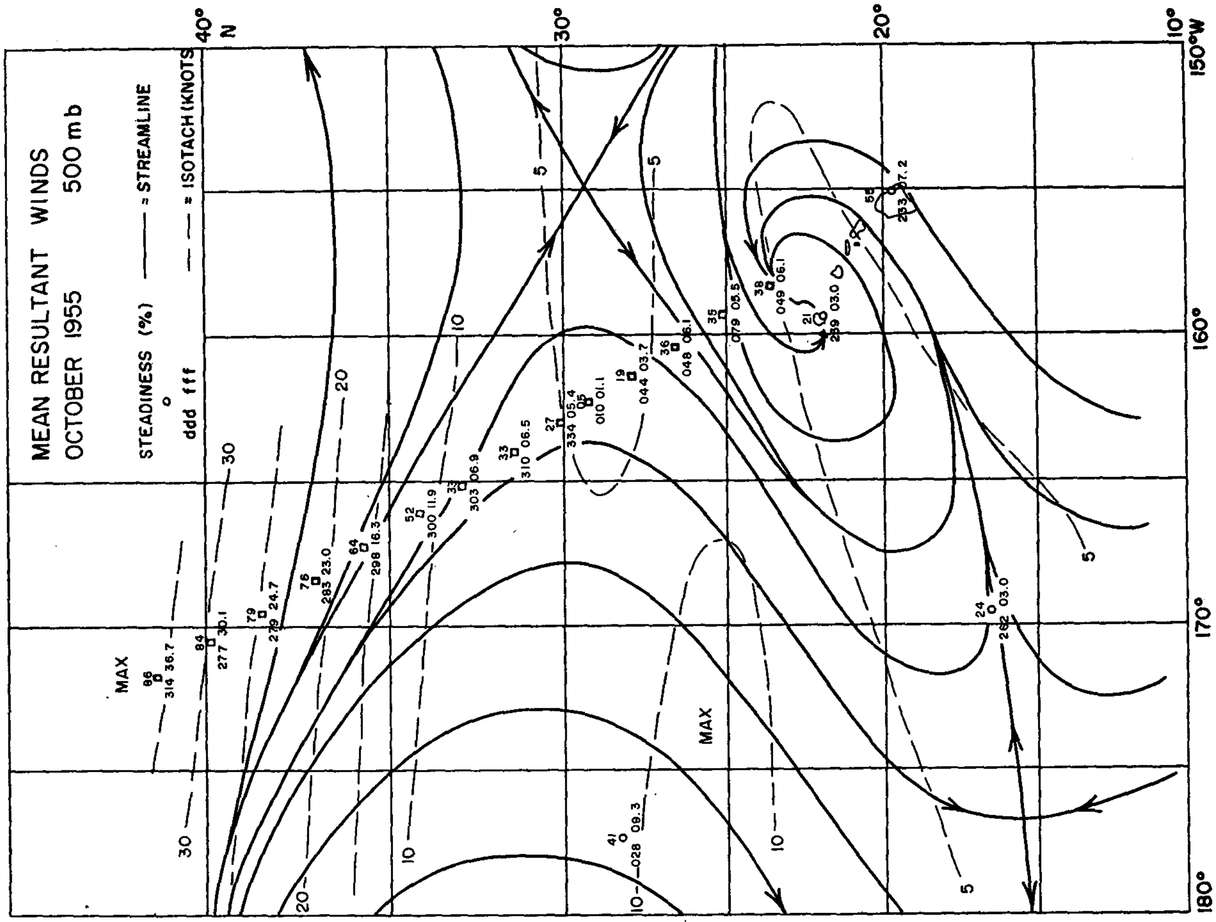

FIGURE 12.—The field of motion at 500 mb., October 1955

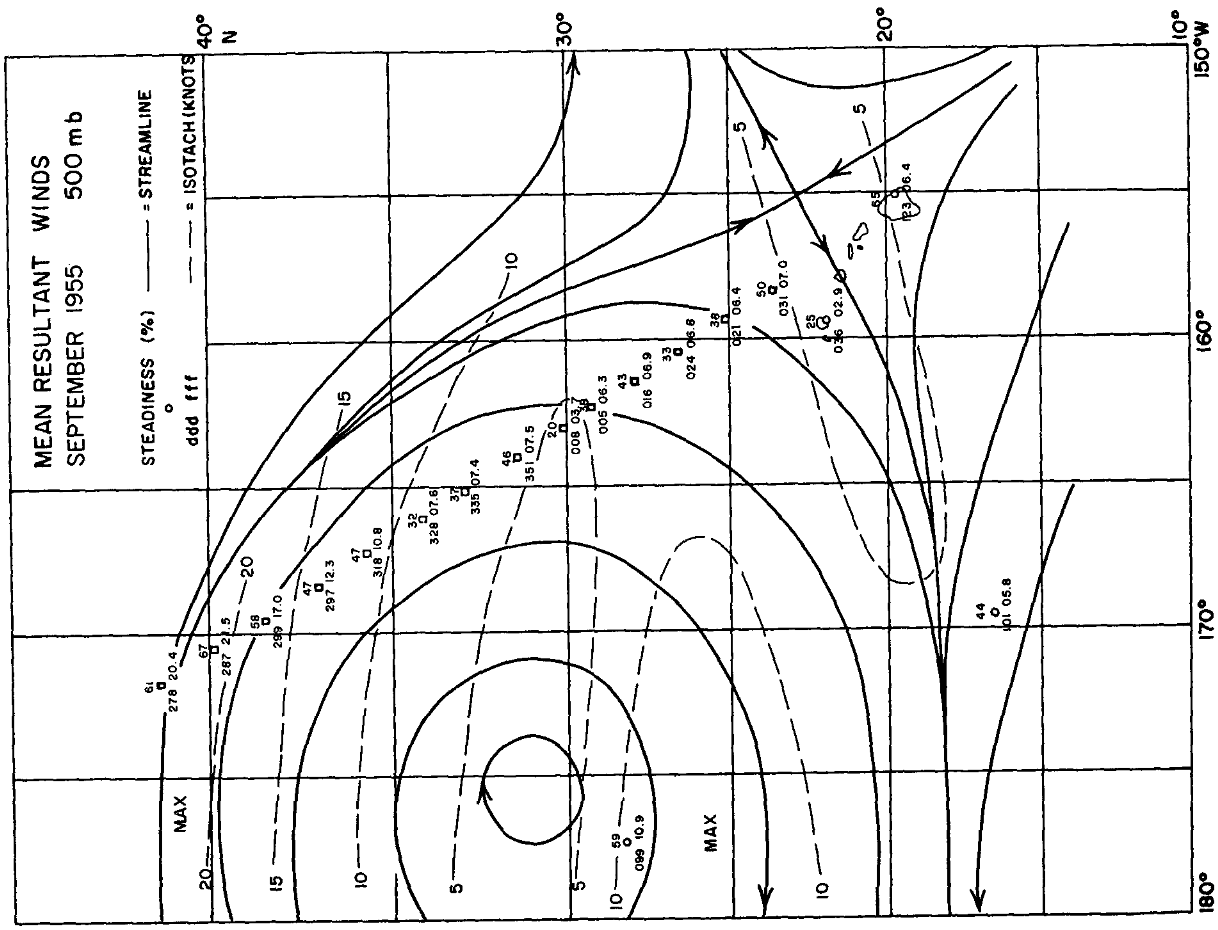

FIGURE 11.—The field of motion at 500 mb., September 1955.

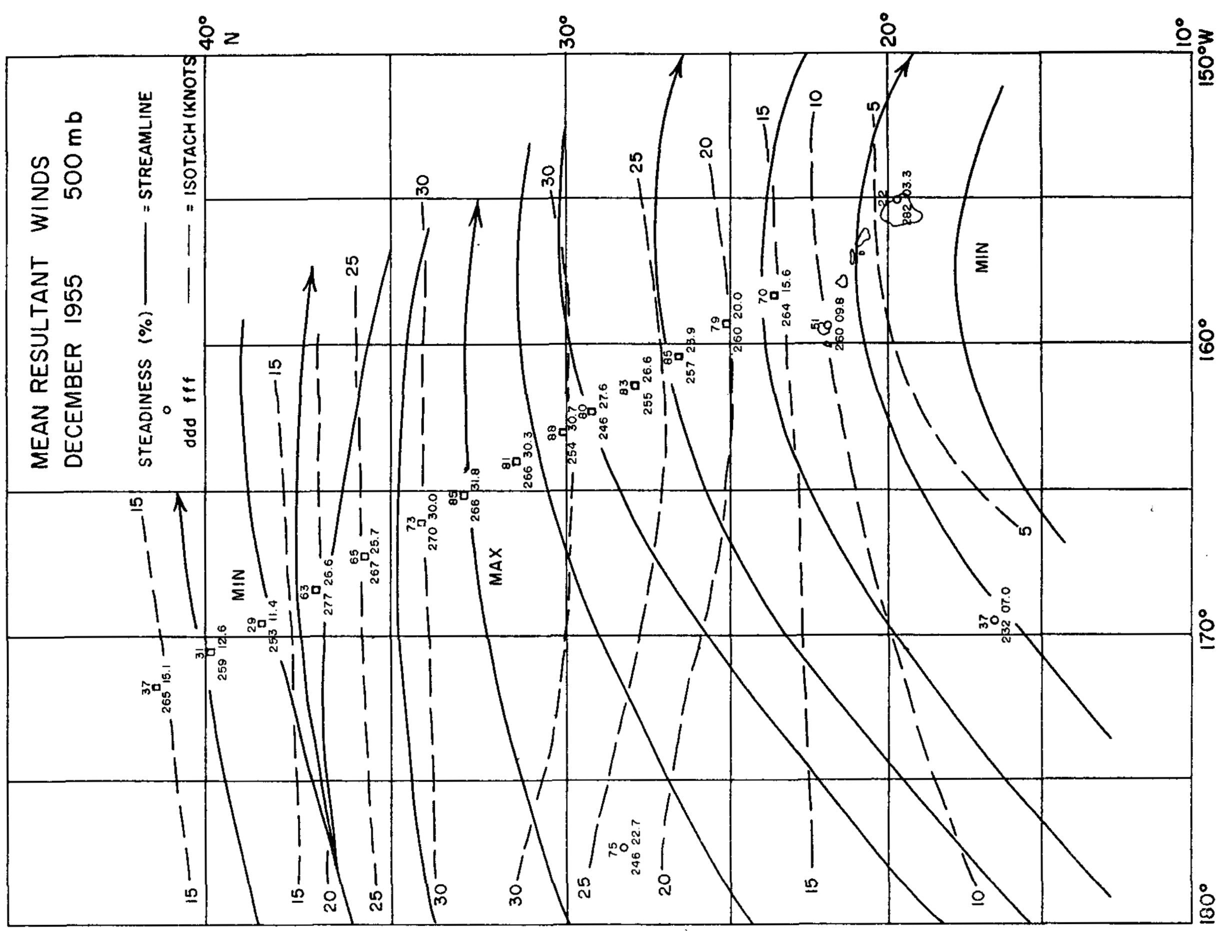

FIGURE 14.—The field of motion at 500 mb., December 1955.

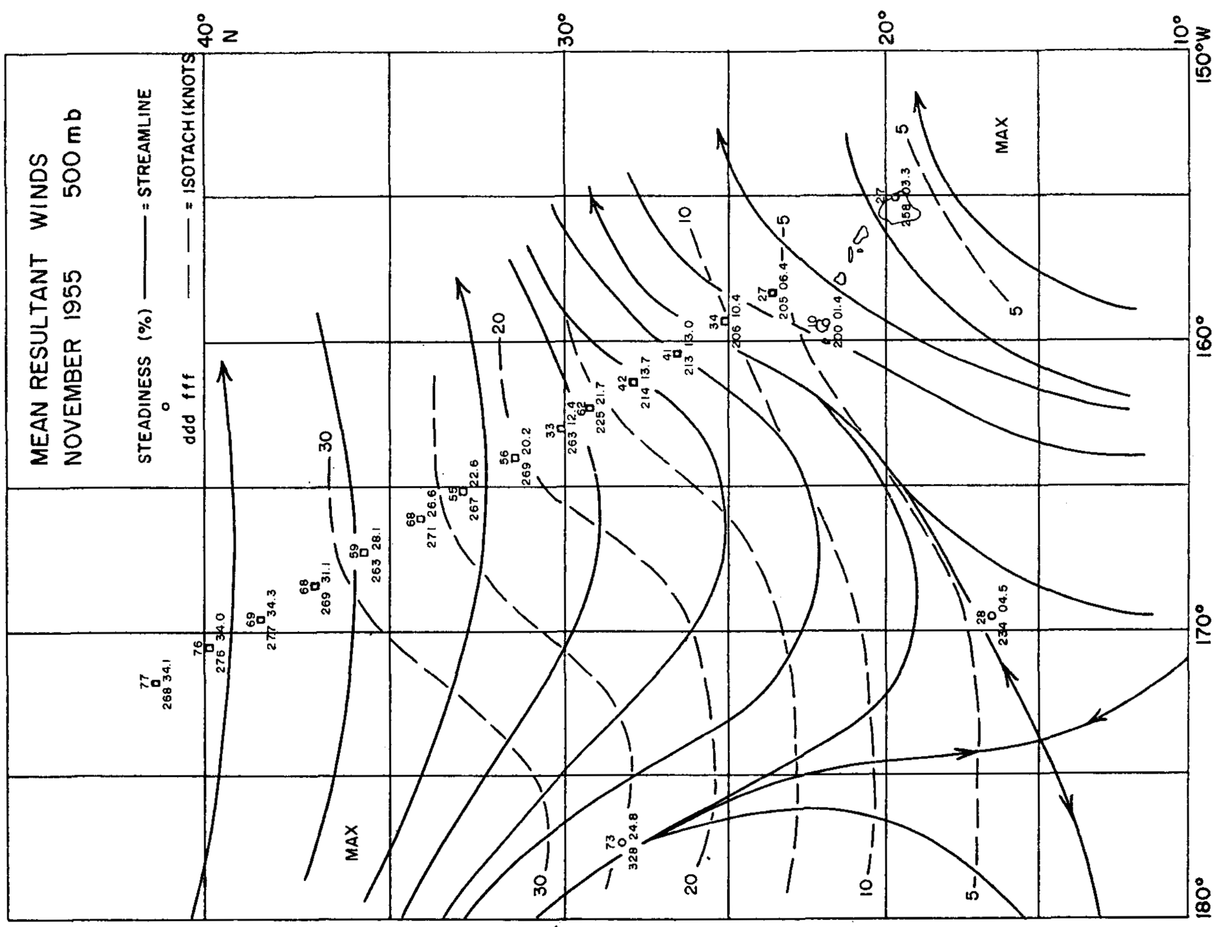

FIGURE 13.—The field of motion at 500 mb., November 1955.

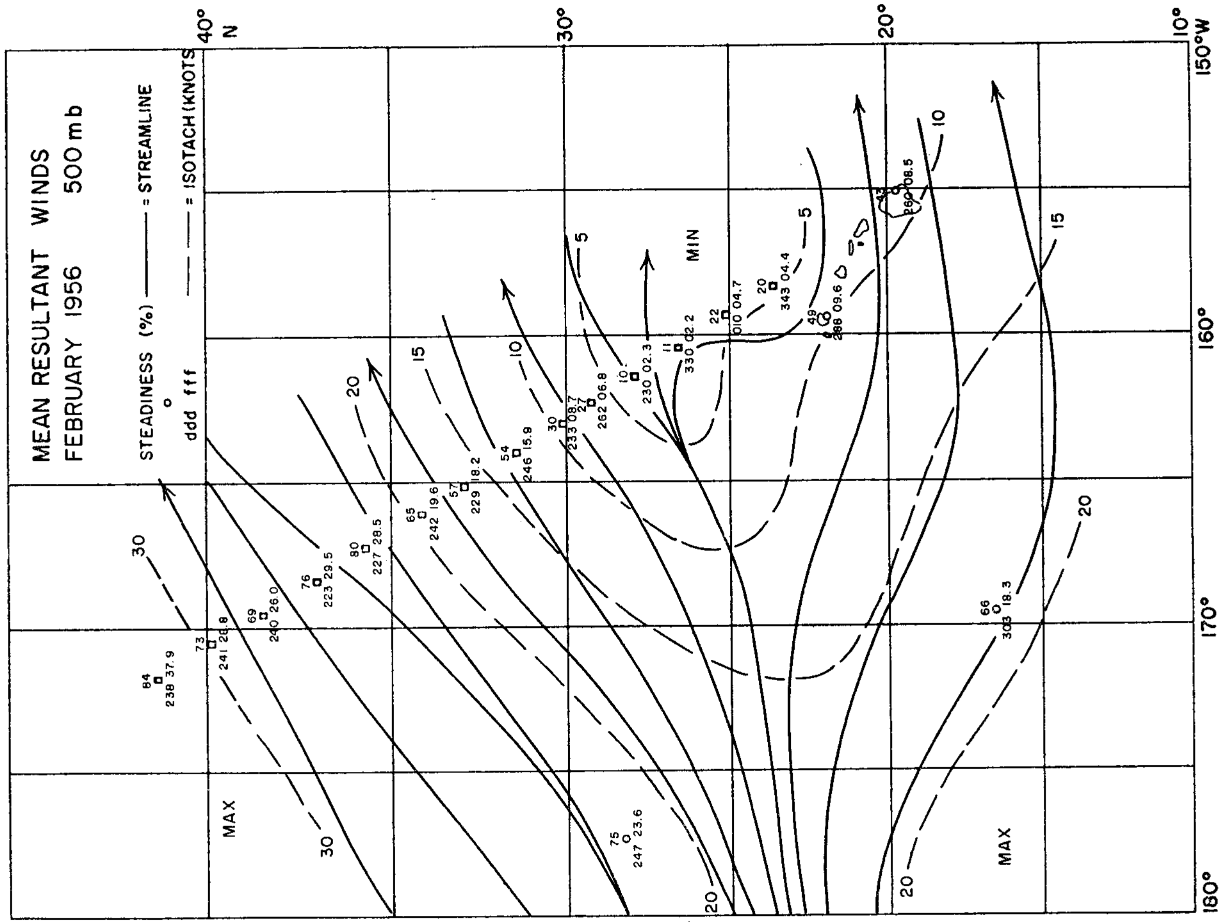

FIGURE 16.—The field of motion at 500 mb., February 1956.

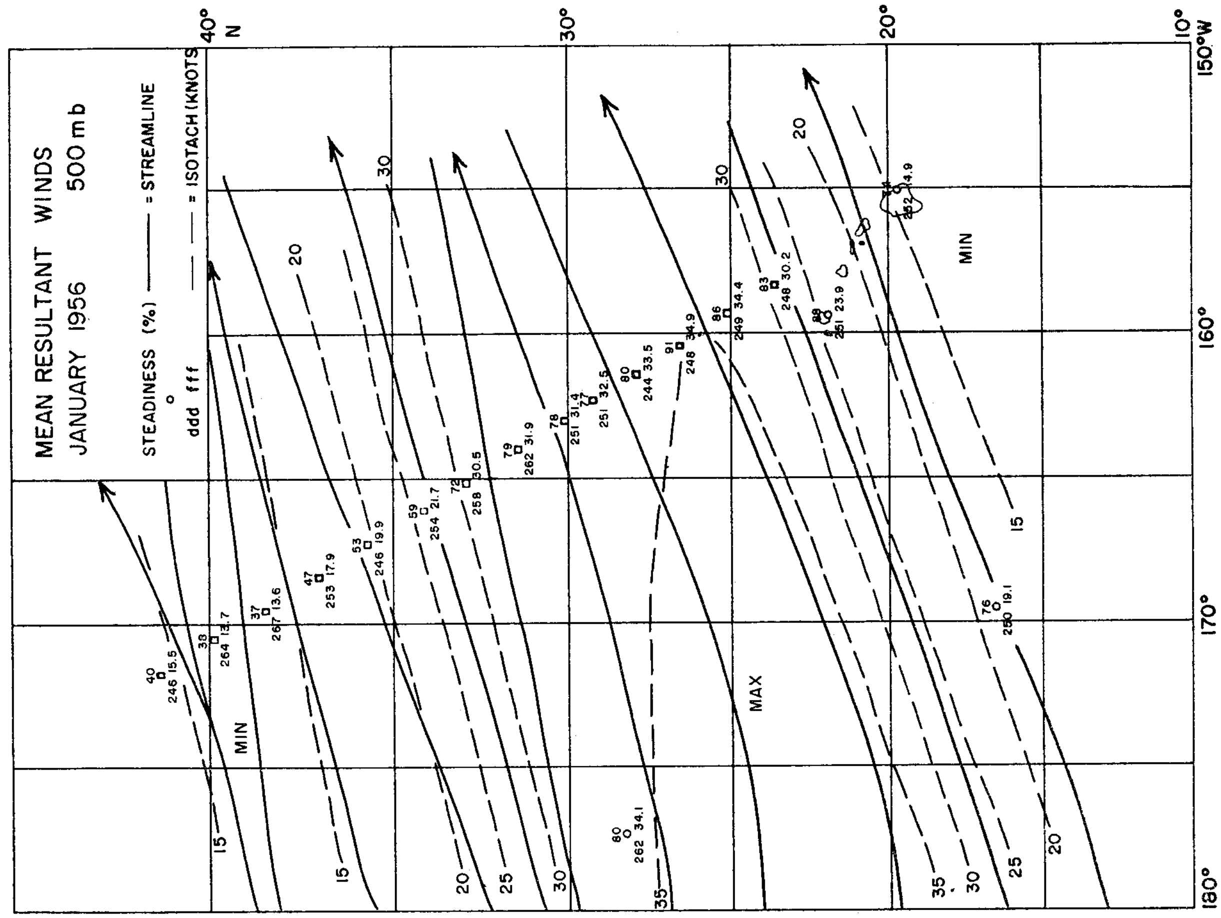

FIGURE 15.—The field of motion at 500 mb., January 1956.

synoptic speed values as high as 100 knots were recorded on individual days during that season. In August the mean winds were very light in speed, although synoptic wind speeds as high as 40 knots were reported.

The mean monthly latitudinal variation of the north-south wind component is shown in figure 3. In general, the mean north-south wind component at 500 mb. was not strong in speed (10 knots) around and to the north of the Hawaiian Islands. Despite its light speed, the patterns of this wind component were systematic over large latitudinal areas.

Figure 4 shows the mean monthly latitudinal variation of the wind steadiness. This figure illustrates that the 500-mb. wind circulation over and around the Hawaiian Islands was highly variable during all months of the year. In general, the areas of low wind steadiness are closely associated with the zero isopleth that separates east from west wind components. High steadiness values correspond with areas of maximum east or west wind components. The low wind steadiness at 500 mb. makes it evident that the analyst encounters considerable difficulties in maintaining continuity (compatible with the large amount of fluctuation in wind direction from day to day). Experience in drawing 500-mb. charts farther west in the Marshall and Caroline Islands area verifies the presence of this problem of maintaining horizontal continuity in analysis. At times, circulation systems appear on charts at this level with no previous continuity. Evidently, intensifying upper-level systems often extend their circulation downward into the 500-mb. surface, or intensifying low-level systems may extend their circulation upward into the 500-mb. surface. It has been shown for the Marshall Islands area, that the 500-mb. level often represents the mean level of transition from lower-level easterlies to upper-level westerlies (Dean [4]). The westerlies are associated with the presence of an east-west oriented upper-level trough or cyclone, and are not part of the wind maximum found in the higher-latitude westerlies. A similar transitional level at 500 mb. in the Hawaiian Islands area apparently existed often enough synoptically to make it appear in the monthly mean charts for the Hawaiian Islands area. These charts are discussed below.

The 1955 mean monthly 500-mb. wind charts (figs. 5–16) depict the most likely wind circulation over an area from 150° W. to 180° and from 15° to 40° N. latitude. In the Hawaiian Islands region during April–November, cyclonic vorticity was apparent in both the speed field and the streamline flow, particularly in the latter. But during the winter season, because of the stronger basic current, cyclonic vorticity appeared only in the speed field.

Another zone of cyclonic vorticity appeared near 35°–40° N. during December and January. This vorticity area resulted from traveling cyclone centers originating in conjunction with the polar front. During all other months of the year, the polar front cyclone centers were poleward of 40° N. in the mean.

An anticyclonic vorticity zone was well defined during all months of the year between 25° and 35° N. This anticyclonic vorticity area appeared in both the streamline and speed fields on the mean maps for the months of April through November; however, during the winter months only the speed field contributed to the anticyclonic vorticity pattern.

The mean wind examples presented have covered only a 12-month period. An estimate of the "climatological representativeness" of the wind maps can be obtained by examining a recent study which shows how typical the annual flow was in the Pacific at 700 mb. during 1955 (Klein [5]). In the area of the southernmost reconnaissance position (position 27, near Kauai) the contour values showed a mean annual negative 50-foot departure from normal, while at the northernmost reconnaissance position (position 14) there was an annual positive 200-foot departure from normal. In addition, these same anomalies appeared for each season. If one can infer that the 500-mb. contour heights showed a similar departure from normal, then the wind charts at 500 mb. probably overemphasize two features: (1) the magnitude of the mean trough or cyclone over Hawaii, and (2) the magnitude of the mean anticyclonic circulation near 30°–35° N.

3. CONCLUSIONS

The 1955 monthly mean 500-mb. wind maps over the Hawaiian Islands area show the presence of an upper-level cyclone or trough. These maps are of special interest to meteorologists in that area since they provide an equatorward extension of the field of motion to the existing high-latitude mean 500-mb. contour charts.

ACKNOWLEDGMENTS

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